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# Half-precessional dynamics of monsoon rainfall near the East African equator: implications for Indian Ocean ITCZ migration over the past 25,000 years

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We present a detailed reconstruction of hydrological changes near the equator in East Africa from before the LGM to the present, using proxies extracted from the sediment record of Lake Challa on the lower east slope of Mt. Kilimanjaro (3° S, 36° E). Our results show that monsoon rainfall in this region varied at half-precessional (~11,500-year) intervals, because the southeasterly and northeasterly Indian Ocean monsoons, which together create the bimodal seasonal distribution of equatorial rainfall, were strengthened in alternation when the inter-hemispheric insolation gradient was maximized. Dry conditions prevailed when neither monsoon was particularly strong, and minima in local March or September insolation weakened the rain season that followed. The distinct timing of late-glacial drought on the equator (20.5-16.5 ka BP) does not fit well with NH glaciation being its primary driver. It is best attributed to partial failure of the short rain season due to modest local September insolation, perhaps exacerbated by the southeasterly monsoon being weakened by northern cooling still affecting the North African land mass. Our data further highlight that orbital-scale ITCZ 'migration', or shifts in its mean annual latitudinal position, mainly relates to variation in how far the ITCZ is displaced into the NH or SH during summer and winter; the cross-equatorial position of the East African region with twice-annual ITCZ passage is not much affected. On (sub)millennial time scales the temporal pattern of hydrological change on the East African equator bears clear signatures of northern high-latitude climate variability, but on the orbital time scale it mainly responded to low-latitude insolation forcing. Important keys to this history are the low-latitude position of its continental regions of convergence and its relative isolation from the Atlantic Ocean domain, where strong meridional overturning circulation more tightly coupled tropical climate regimes to high-latitude climate dynamics.